BATTLEFIELD VISUALIZATON: "WE CAN'T GET THERE FROM HERE"

A MONOGRAPH
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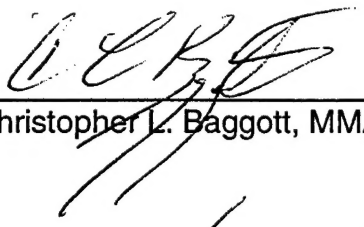

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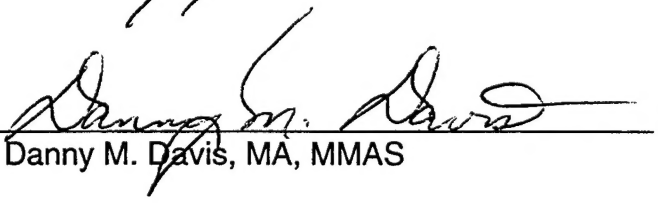

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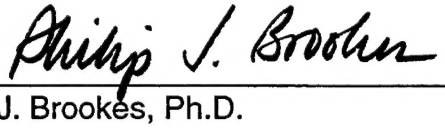

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ABSTRACT

Battlefield Visualization: We Can't Get There From Here by MAJ Gregory D. Reilly, USA, 47 Pages.

The Army "Battlefield Visualization Concept" is the center piece of Battle Command. A key component of battlefield visualization is understanding how terrain and the spatial aspects of the environment impact on military operations. This monograph provides evidence that suggests maneuver battalion commanders may fall short in properly visualizing the battlefield when planning and conducting offensive operations. It answers the question: has emphasis diminished in developing skills in mid-level officers at the Army Command and General Staff College (CGSC) that may contribute to visualizing the battlefield?

To answer the research question a review of theory, doctrine and behavioral research identified skills that may contribute to developing battlefield visualization abilities. These skills included spatial orientation ability, terrain pattern recognition and exposure to military problem-solving with a map, and on the ground. A comparison of curriculum was conducted between three academic years (1939,1969,1996) at CGSC to determine if emphasis has diminished in developing these skills..

The analysis concluded that emphasis in developing skills that may contribute to officer's terrain visualization abilities has diminished. The monograph answered a small question which is clearly linked to larger concept. As the Army increases its reliance on technologies that improve the commander's situational awareness on the battlefield, it seems as though emphasis on developing fundamental skills declines. Implications and recommendations are provided.

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INTRODUCTION

> Winning in combat requires many things: excellent techniques, understanding of the battlefield, an appreciation of the opponent, exemplary leadership, battlefield judgment, and combat power.
>
> A.M. Gray FMFM 1-3, Tactics[1]

Visualization of the battlefield is more than the physical act of observing the battleground.[2] It is a cognitive reconstruction of the battlefield framework that allows the commander to see the enemy and friendly forces, terrain and weather, in terms of time, space and purpose.[3] In order for the maneuver battalion commander to visualize an operation he must synthesize large quantities of information about the environment, friendly and enemy forces so that he can fabricate a mental picture of an operation from its inception through its end-state. A doctrinal tool designed to improve the commander's understanding of the enemy and the environment is the intelligence preparation of the battlefield (IPB) process. The IPB process is a systematic, continuous process of analyzing the threat and the environment in a specific geographical area.[4] The commander relies on IPB to determine enemy composition, his array of forces and how terrain impacts on enemy and friendly courses of action. Intelligence preparation of the battlefield is a process that is critical to the commander in planning and conducting combat operations. He depends on information collected during IPB to formulate tactical solutions that achieve mission objectives. The battalion commander relies on his staff and specifically the intelligence officer (S2) to assemble information and provide analysis during IPB, yet it is the commander who is overall responsible for the quality of analysis, and more importantly, the interpretation of data from which he makes decisions.

Army doctrine provides procedures, guidance techniques and procedures to perform IPB in Army Field Manual 34-130. But is competency in performing doctrinal procedures, alone, enough to develop the skills a maneuver battalion commander needs to visualize the enemy and the environment when planning offensive operations? How does the commander translate information he receives regarding the enemy and terrain into an ability to visualize an operation? Are there leader competencies associated with bridging the gap between what the leader has in the form of information and how he visualizes the battlefield environment?

The mission of the National Training Center (NTC) at Fort Irwin, California is to provide highly realistic and intensive combined arms and services training in accordance with Air-Land-Battle doctrine in a mid to high intensity combat environment, while retaining feedback and analysis focus at the battalion task force level.[5] Since 1981 the NTC has served as the Army's tactical simulation battle lab for developing lessons learned and improving tactics techniques and procedures. At the battalion and brigade level, the NTC provides the most challenging and realistic training afforded to Army maneuver units, however, the NTC falls short in replicating the moral domain of the battlefield, such as danger, fear, and the psychological conditions soldiers would actually face during combat. With this in mind, the relevance of conclusions drawn from tactical operations conducted at the NTC to actual combat are limited. Nevertheless, as the Army's primary tactical battle lab, conclusions drawn from exercises at the NTC provide insight into the formulation of Army training doctrine and training.

There is evidence that suggests maneuver battalion commanders fall short in applying analysis derived from the IPB process when planning offensive operations.

Observers at the NTC frequently note that maneuver battalion commanders often fall short in this regard. Observers note that in many cases commanders have timely and accurate information pertaining to the enemy and the terrain, however, fail to properly understand and apply this information when developing and wargaming the plan in terms of time and space.[6] As a result, task forces conducting offensive operations often stumble directly into fortified and entrenched enemy positions and quickly experience defeat. Even those task forces that do properly conduct IPB and wargaming often attack and close with the enemy only to find themselves in a position on unfavorable ground and within direct fire range of the enemy which leaves maneuver units incapable of massing combat power.[7]

In addition to observations made at the National Training Center, combat operations conducted during Desert Storm also suggest that IPB may not have been properly incorporated during the planning of offensive operations. Knight Strike I, a VII Corps deception operation that was conducted prior to the ground war illustrates this point clearly. Knight Strike I was a Task Force reconnaissance-in-force operation conducted on 20 February 1992. The operation was conducted near the Wadi-Albatin to deceive the Iraqi forces as to the actual location of the VII Corps main attack, however, if the operation experienced minor resistance during the attack then VII corps would consider conducting the main attack along the Wadi-Albatin.[8] Despite having excellent intelligence provided by VII Corps and theater level resources, the task force attacked with a M2 Bradley company team leading and stumbled into an Iraqi tank platoon defensive engagement area which resulted in several friendly vehicles and an Apache helicopter being destroyed by direct fire. It is not clear why the task force commander

decided to lead with Bradley fighting Vehicles in a desert environment knowing that an anti-tank threat existed. Given the advantages of accurate intelligence and superior weapons systems, one must question if information that was derived from the IPB process was incorporated into the plan. Although the deception operation was regarded as a success, the impact of receiving unanticipated and effective direct fire resulted in the operation coming to a quick halt with nine soldiers wounded and three soldiers being killed.[9]

Command is widely accepted as a personal endeavor, but certain qualities in a commander are regarded as essential if he is to master the tactical art. According to Roger Nye, in his book "The Challenge of Command" after interviewing many battle proven company and battalion level commanders, including Generals George S. Patton Jr., he concluded that there are four areas where the skills and knowledge of the commander are vital in developing tactical competency: terrain, hardware, doctrine and capacity for creativity.[10] This monograph focuses on the skills relevant to understanding terrain analysis which Roger Nye recognizes as a component of understanding tactics.

The focus of this monograph is to determine if emphasis has decreased on developing officer skills that may contribute to ability of the maneuver battalion commander to visualize the battlefield. Given the evidence that suggests maneuver battalion commanders fall short in this regard, one question certainly arises. Could there be an oversight in the formal training of officers on a few fundamental skills that may hinder terrain visualization development?

Army research suggests that there may be certain cognitive abilities that contribute to one's ability to visualize. The commander must be able to visualize the terrain and its

military significance, and visualize the fight.[11] The ability to visualize the fight may be linked to one's spatial abilities. Spatial orientation ability is the ability to maintain bearing with respect to positional instruments and to maintain one's location relative to the environment. Spatial visualization is the ability to mentally envision three dimensional patterns from two dimensional instruments in relation to distance and direction (map).[12] As a component of battlefield visualization, understanding of how the characteristics of terrain impact on tactical offensive operations, in relation to enemy actions, will remain vital into the 21st Century.

One would think that technology will progress to reduce the need to develop simple cognitive skills such as spatial ability, however, data produced at the NTC and analysis of Knight Strike I during the Gulf War may suggest otherwise. This point was echoed in a concluding observation after the Army Warfighting Experiment (Desert Hammer VI, 1994) by a senior OC: "The commander must see the battlefield as a precondition for directing his unit to maneuver and shape the battlefield. Only by appreciating the terrain, enemy, and friendly forces can the commander identify and choose those times and locations at which favorable conditions can be achieved."[13] Experience is proving that digital visualization has its limitations and there will continue to be a need for the commander's visual situational awareness.[14]

There can be little doubt that new technology transforms the manner in which terrain can be used, but not the essentially of matching terrain with the capabilities of weapons and formations. "The ability to read a map, and to see terrain through its symbols and elevation lines, seems to increase rather than diminish with new

technology."[15] Is the Army losing focus and neglecting to emphasize fundamental skills that are required to make new technologies work?

As technology advances, leader competency of digital tasks will likely increase, but observation and analysis of recent Army Warfighting Experiments (AWE) suggests that a more fundamental requirement exist for development of visualization skills. A task force that makes a tactical error and attacks the strength of an enemy position is still likely to have an unsuccessful mission outcome, whether the force is digital or not.[16] Given this, it would seem that regardless of the capabilities that are brought to the battlefield, successful employment of those capabilities at the right place and time will remain a human endeavor. Technology such as the global positioning system (GPS) illustrate this point clearly. The GPS provides the user very accurate navigational information to include current user location and the direction and distance to selected points from that location. The system greatly reduces the navigational requirements of the user when navigating from point to point. The system does not, however, select the points that are entered for navigation or provide selection criteria for optimum reckoning given an enemy situation. The system's utility is limited by the understanding of the user's terrain analysis skills.

The proposed monograph is not an attempt to reduce tactical offensive planning merely to a science or place unwarranted emphasis on a process or methodology. It is important, however, to analyze possible training shortfalls that may contribute to failure at the NTC and more importantly during actual combat operations. As a component of battlefield visualization, understanding how the characteristics of terrain impact on friendly and enemy tactical offensive operations will remain vital into the 21st Century.

REVIEW OF LITERATURE

The purpose of the literature review is to present evidence from which to formulate a hypothesis and identify possible criteria that will be used in answering the research question. The review begins by defining battle command and battlefield visualization. Military theory and Army doctrine are reviewed to explore the military significance of terrain in military operations and to identify current Army considerations when planning and conducting offensive operations. Once the considerations are identified, a review of current Army research is presented in an attempt to bracket the skills a maneuver battalion commander may need to understand and visualize the impact of terrain when planning and conducting offensive operations. Finally, distilled directly from the literature, a hypothesis is formulated and the criteria for analysis is defined.

The term "battle command" has rapidly spread throughout the United States Army during the last five years. Battle command is a term that originated from the British Command Manual (1993) and is defined in U.S. Army doctrine as: "the art of battle decision making, leading and motivating soldiers and their organizations into action to accomplish a mission. It includes visualizing the current and future state, then formulating concepts to get from one to the other at least cost."[17] This definition suggests that battle command is a component of leadership during both peacetime and in war. In order to understand how battlefield visualization is a key component of battle command at the tactical level, a narrower definition is required.

The NTC has its own unique definition of battle command, which is derived from its mission to coach, train and teach battle command concepts specifying that: "battle command is captured in the visualization of terrain, enemy- and self, in time, space, and

purpose."[18] The link between battlefield visualization and battle command is provided in the Army Battlefield Visualization Concept which states: "battlefield visualization lies at the center of battle command. . .and is an essential leadership attribute of the commander and is critical to accomplishing the mission."[19] Because battlefield vision emanates from the commander, it is recognized that technology, alone, cannot provide the commander with a full visualization of the battlefield. There are cognitive skills of the commander that enable him to translate "knowing the battlefield into seeing and understanding it"[20] As digitization of the battlefield increases information available to the commander he will still need to rely on his experience, wisdom and intuition when visualizing the current and future state of operations.[21]

Battlefield visualization is both a science and an art.[22] The art of battlefield visualization suggests that it is a human endeavor where the commander relies on his holistic skills to sort through information when visualizing the nature of battlefield activities.[23] Visualizing the battlefield includes perceptually seeing how, in relation to time, space-and purpose, the environment, and the enemy impact on the tactical situation. The art of battlefield visualization includes: understanding the current state of friendly and enemy force; discern a desired end state; to see and understand the dynamic relationship between the opposing forces.[24] By visualizing the battlefield the commander anticipates the decisions and possible moves of the enemy and counters these moves by shifting fires, the main effort or transitioning to branches or sequels, just to name a few.

Under the visualization concept, technology is leveraged in four areas to support the needs of the commander. It is in these four areas that the science of battlefield visualization comes into play. Technology improves the commanders ability to visualize

the battlefield by enhancing total mission awareness, mission planning, rehearsals and execution.[25] As a key component of the commander's total mission awareness, technology is being developed to improve terrain visualization. These developments include digital terrain map products and terra base technologies. Both of these products will improve the commander's ability to see the ground when planning operations. Technology may broaden the tools available to the commander aimed at improving his understanding the impact of terrain on operations, but is this enough? Does the commander formally learn how to recognize, classify and employ terrain considerations during planning and execution of offensive operations?

Although the battlefield visualization concept articulates thoroughly the components that contribute to enhancing the science and art of battlefield visualization, it appears that the "how" is left somewhat unanswered. How does the commander transfer information into understanding so that he can he can make judgments from which to accurately visualize. This is referred to as the art of battlefield visualization. Defining the cognitive processes that do contribute to developing the commander's art in battlefield visualization is an area limited in understanding and one that has behavioral scientist working hard to try and identify. The visualization concept suggests that the "art" of battlefield visualization is developed through training and experience and lies within the wisdom and intuition of the commander to employ. It assumes that the commander relies on fundamental skills developed through training and education, that he is grounded in the science of warfare. With this in mind, can skills be identified that may contribute to the commander's ability to visualize information he gains from terrain

analysis and determine its significance on military operations? It is this question that that the literature review intends to explore.

Theory

The concept of battlefield visualization is not much different today than a term used by Frederick The Great of Prussia in 1747 called coup d'oeil. Frederick the Great is recognized by military historians for his tactical insight and expertise. In his "Instruction to his Generals," Frederick placed special emphasis on the commander's perceptual understanding of terrain, stating that: "coup d'oeil is the talent which great men have of conceiving in a moment all the advantages of the terrain and the use that they can make of it with their enemy."[26] Frederick went to great lengths to explain situationally how terrain afforded the attacker and the defender advantages. He understood that the ability to mass fires, the ranges of fire and rate of movements of his forces were inherently dependent on the terrain.

The classical military theorist, Carl von Clausewitz placed special emphasis on the commander's intellect when assessing terrain. Clausewitz recognized that terrain was a permanent factor in warfare and "its importance was decisive in the highest degree for it affects the operations of all forces, and at times entirely alters them."[27] In explaining the significance of terrain he points out that the ground's influence may be felt by the very smallest features which could dominate enormous areas. Clausewitz believed that the commander's ability to accurately grasp the topography of any area was a mental gift bound by his imagination. Clausewitz believed that the commander's imagination

enabled him to recall from memory the subtle aspects of terrain that were previously conveyed from maps or reconnaissance.

Carl Von Clausewitz also recognized the tactical importance of terrain analysis when planning and conducting tactical operations. Clausewitz stated that the geography of the ground can affect military operations in three ways: as an obstacle to the approach, as an impediment to visibility, and as cover from fire. He explained that this threefold effect of terrain tends to make military activity more varied, complex and skillful.[28] In his classic "On War" Clausewitz dedicates an entire chapter to how terrain impacts on military operations. Both Frederick and Clausewitz understood that the commander who could position his forces on favorable ground once hostilities commenced would enjoy a marked advantage. Clausewitz makes this point when explaining the inherent strength of defensive operations over the offense and pointed to the idea that well prepared defenses on familiar ground was the key ingredient to its strength.[29] Clausewitz also stated that three elements could overcome the advantage of the defense: surprise, the benefit of terrain and concentration.[30] Clausewitz clearly emphasizes terrain as a significant consideration when planning and conducting both offensive and defensive operations.

The fundamental classification of terrain types and the association of terrain to tactical principles are generally attributed to Sun-tzu.[31] Sun-tzu listed terrain as one of his five major factors in warfare, stating that the commander who did not understand the nature of terrain on military operations would certainly be defeated.[32] Sun-tzu went beyond stating the general nature of terrain and its impact on operations, he believed that everything in warfare was based on terrain. He believed that terrain "gave birth to

measurement and lead in turn to the forces required and their configuration."[33] Sun-tzu classified terrain into nine different categories and presented the attributes of each. He went as far as to provide specific situations applicable to each in which forces should be arrayed and where advantages and disadvantages exist.

It is evident that military theory emphasizes the significance of terrain on military operations. It is also evident that the Army's current battlefield visualization concept also recognizes the importance of terrain and the commander's ability to understand its impact when planning and conducting operations. Given this, does current Army doctrine specify how to thoroughly conduct terrain analysis and incorporate terrain considerations into planning and execution?

Doctrine

The Army's primary reference pertaining to how the maneuver battalion fights is Army Field Manual 71-123.[34] This manual bridges the gap between Army doctrinal concepts and mission training plan check lists.[35] Listed under troop leading procedures is the process of terrain analysis. Terrain analysis is conducted during step three (make a tentative plan) whereby the intelligence officer (S2) generates a combined obstacle overlay and conducts a battle area evaluation. It is during this process that the commander, the S2 and the staff conduct an estimate of the terrain when planning operations. FM 71-123 specifies that terrain is analyzed using the five military aspects of terrain: obstacles, cover and concealment, observation and fields of fire, key terrain and avenues of approach. The S2 builds the combined obstacle overlay by labeling terrain graphically as go, slow-go, and no-go terrain. In addition, key terrain, mobility corridors

and enemy positions are templated and posted on the overlay. It is from this graphic that the commander begins visualizing the battlefield.

Army techniques and procedures vaguely emphasize how to use terrain when conducting deliberate offensive operations. This is evident when examining procedures for conducting deliberate offensive operations. When planning a deliberate attack the brigade commander will usually specify a task force as the support force and another as the support force. During preparation for the attack, maneuver battalion commanders should "rehearse the best approach routes according to terrain, and change formations as necessary to establish both support and assault force formations."[36] It is interesting, however, that FM 71-123 does not specify terrain considerations for planning approach marches, support by fire positions or assault locations. Even the illustrations intended to depict attack formations and objective positions fail to illustrate favorable terrain from which to establish these positions. One would think that our "how to fight" procedures would offer techniques that place some emphasis on how to use terrain.

Army field manual 71-2, The Tank and Mechanized Infantry Battalion Task Force, serves as the Army's doctrine for maneuver battalion operations. In describing "techniques for the deliberate attack" the manual gives little reference for the use of terrain when conducting the deliberate attack. It does suggests that smoke be employed to provide concealment of attacking forces, and refers to the IPB process when addressing the significance of the enemy and terrain on operations. Doctrine for conducting offensive operations is prescriptive, specifying in detail the sequence of activities when conducting operations, but giving little consideration to how environmental factors impact on these activities. Again, doctrine does not emphasize

how terrain may alter techniques for conducting offensive operations or indicate how terrain is recognized and characterized.[37]

Given what has been presented from military theory about the strength of prepared defenses, and the critical use of terrain in offensive operations, should there be more emphasis on terrain considerations in doctrine? In planning and rehearsing support by fire positions, one consideration may be to ensure that positions selected offers an adequate opportunity to acquire and identify enemy positions, in advance, and at ranges that favor the attacking element. Furthermore, it may be prudent to establish possible areas or lines of contact so that actions are taken before contact. Little, if any attention is given to recognizing the advantages and disadvantages of intervisibility lines, line of drift, or defiles and how these characteristics of terrain impact on military operations. Our how to fight manuals emphasize rehearsals of friendly actions on contact, it would seem that emphasis on actions before contact would do more to ensure that favorable conditions exist when initial contact is made.

The techniques employed by the Opposing Forces (OPFOR) at the NTC provide an interesting perspective on the use of terrain when conducting battalion size maneuver operations. The NTC OPFOR consistently achieves mission objectives when fighting U.S. Army maneuver battalions. The OPFOR rely on "Decision-Point Tactics" as their basic technique for planning and conducting operations. Decision-point tactics do not deviate from Army doctrine, but emphasize common sense as applied to the battlefield. Decision point tactics place special emphasis on making decisions directly related to threat force activity and the battlefield environment.[38] Decision-point tactics techniques thoroughly assess battlefield activities in relation to the terrain, enemy, time, and troops.

Details of how to utilize these factors relative to the technique is explained. Heavy emphasis is placed on terrain, especially in terms of time and space. Sketches used to illustrate tactical execution, unlike those in Army doctrine, are actually depicted on imagery photos. The OPFOR is not unlike any other Army unit, in fact it is an Army unit which has developed an understanding of how to implement doctrine and more specifically, an understanding of how terrain impacts on operations relative to the enemy.

Intelligence preparation of the battlefield (IPB) is a systematic, continuous process of analyzing the threat and the environment in a specific geographical area.[39] The IPB process provides very specific steps to consider in analyzing terrain for military operations. Again, the five military aspects of terrain are defined and considerations of the environment on operations are covered. The manual, however, only lists considerations when evaluating terrain and conducting battle area evaluations and does not specify how to actually interpret the map. To actually evaluate terrain, one must consult Army field manual 5-33 Terrain Analysis. Herein lies the actual process of categorizing map information into usable information when planning and executing military operations. To illustrate the detail of this manual, it provides no less than the seven procedures for determining lines of site and zones of entry.[40] It also prescribes techniques for map and photo interpretation, which enables one to plot map data so that it can be viewed from the side, thus changes in terrain can be graphically seen. The proponent of the publication is the Army engineer school and is not issued to students at the Army Command and General Staff Officer Course.

It would seem that maneuver commanders could rely solely on their training and experience to develop the skills required to interpret, make judgments and visualize

information regarding the terrain, but are officers formally exposed to the process enabling the development of these skills. The Army military qualification standards (MQS) system establishes a blueprint for officer training and leader development in both resident schools and units.[41] It is also intended to identify standards company grade officers should meet prior to selection to major and attending the Command and General Staff College. The military qualification standards for lieutenants and captains requires that officers be proficient in navigating form one point to another both mounted and dismounted using a compass and a map.[42] There is no requirement to classify, identify, recognize or analyze the military aspects of terrain.

The military qualification standards for armor branch company grade officers increases officer requirements for terrain analysis. The MQS for company grade armor officers requires that officers perform a map reconnaissance and specifically identify observation locations and fields of fire, cover and concealment, avenues of approach, and key terrain. It is obvious that there are differences in standards that are specific to an officer's branch. However, neither MQS publications outline a process of interpreting analysis on terrain evaluation.

Army doctrine and related manuals that prescribe techniques and procedures pertinent to conducting terrain analysis when planning and executing battalion offensive operations fall short on emphasizing how to conduct terrain analysis. Although FM 71-123 lists the military aspects of terrain when planning operations it falls short in providing understanding of how the attributes of terrain are recognized, or how terrain impacts on operations. Moreover, our how to fight manuals do not identify how to recognize the advantages and disadvantages of terrain on military operations.

Visualizing the battlefield requires that the maneuver commander understand the impact of terrain on both friendly and enemy forces. Terrain visualization enables the maneuver commander to associate actions of the enemy in both time and space in relation to the friendly situation. Given this, the review of Army authoritative sources on how to fight and the officer skills that are essential, may not be emphasizing enough the critical impact of terrain on military operations.

Army Research

The Army has conducted extensive research studies aimed at identifying leadership skills and competencies associated with understanding and improving the commander's battlefield visualization. Army studies conducted by the Rand Corporation and the Army Research Institute (ARI) measure a wide range of variables that may contribute to the commander's ability to analyze terrain, see the enemy, and anticipate battlefield events before they unfold. This monograph is interested in research aimed at identifying possible skills that may contribute to enhancing the maneuver commander's ability to visualize terrain and understand its impact on military operations. Research conducted in this area focuses on how the commander synthesizes information from which he constructs mental images that enable him to envision events as they are planned and possible outcomes. The review that follows includes: research on the theory of expertise, individual spatial ability as it applies to perceptual abilities, and terrain pattern recognition. The review begins with research that suggests that one's level of expertise is associated with ability to transform information into visualization of the battlefield.[43]

The theory of expertise explains how one transforms information into visualization. It is commonly understood that expertise is developed from experience

and exposure to many situations within a given area. Through training, experience, and education, expertise is developed.[44] Research conducted by Shanteau (1987) identified three dimensions that can be used to distinguish types of experts, and the dimension associated with visualization is perceptual expertise.[45] Research has identified three primary aspects unique to perceptual expertise. The first aspect is that experts have the ability to see typically or make perceptual assessments about a situation given a reference that is typical. The second aspect is that experts are able make perceptual distinctions between situations. Given fine differences in situations, experts are able to make fine discriminations and make appropriate judgments.[46] The third aspect of perceptual expertise enables experts to visualize how a situation developed into its current state and how it will continue to develop.

The theory is significant because it explains partially the cognitive requirements that enable one to transfer knowledge or information into understanding. It suggests that as one is exposed, trained and learns to recognize the components that impact on his area of expertise, he begins to understand the meaning of information that may alter that area.

Another competency that research suggests is linked to visualization is spatial ability. In a Army research study aimed at identifying reasons for high failure rates at the Army special forces land navigation course, it was found that spatial orientation skills were strongly correlated with land navigational ability.[47] Spatial orientation ability is the ability to maintain bearing with respect to positional instruments and to maintain one's location relative to the environment. Spatial visualization is the ability to mentally envision three dimensional patterns from two dimensional instruments in relation to distance and direction (map). The research set out to determine if individual abilities are

correlated with land navigation performance. The study found that fiscal fitness and intelligence testing were not correlated with land navigation performance. The study did find, however, a strong correlation between students who scored high in initial spatial tests and land navigation performance.[48] Specifically, students who could associate terrain in three dimensional patterns from three dimensional maps, and had high orientation ability from those patterns (direction and distance) scored higher on the land navigation course. The study found that prior individual experience in land navigation was also correlated positively with scores on the special forces land navigation test. The study mentioned that students who had completed training at the Army Ranger school performed better than students without that experience.

This study suggests that individual spatial abilities contribute to one's ability to see perceptually from maps in terms of space, distance and direction. It also suggests that these abilities may derived through training and experience.

In another study conducted by Rand, analysis concluded that ones ability to recall attributes of terrain, locations and directions, after studying maps was significantly correlated to the strategy used by the individual to classify information. In this study, subjects were given instructional techniques to study features of different types of maps and were then given a series of tests to measure how well students were able to recall map information. The tests were designed to measure the degree in which individuals could visualize information from a map. It was found that subjects who were able to apply the techniques taught and apply the appropriate strategy to map situations scored higher than subjects who did not.[49] This is interesting because it suggests that individuals, to some degree, may be trained to improve their recall visualization ability.

In another research study conducted by the United States Army Research Institute, it was found that terrain pattern recognition could be taught to individuals without deploying to the field. This research was able to raise ROTC cadet's terrain pattern recognition levels to that of Army captains by teaching terrain recognition skills in the classroom.[50] The subjects were taught how to recognize terrain features and how these features are visually represented. In addition, subjects were taught how to recognize the military significance of terrain patterns. It is not known whether terrain pattern recognition is a skill that improves the commander's ability to interpret visual stimuli in the forms of maps and overlays, research in this area is still needed. However, it is understood that commanders must quickly grasp the attributes of the battlefield environment if he is to accurately visualize how they impact on operations. This research is significant in that it demonstrates again that individuals can be taught, and with practice, are able to delineate the physical attributes of terrain from maps.

Scientific research provides unique insight into the possible development of battlefield visualization skills at the tactical level. In the context of the maneuver battalion commander, the ability to accurately visualize the terrain and the spatial relationships of the environment would depend on his experience and exposure to multiple situations. Research suggests that experience and training leads to expertise and expertise enables one to see perceptually against what is understood as typical. One's level of perceptual expertise may determine one's ability to see how subtle battlefield attributes impact on offensive planning and execution. In addition, spatial skills were found to be correlated to one's ability to envision three dimensional patterns from two dimensional maps. Spatial ability is one's ability to associate aspects of terrain with location,

distance, and bearing. Research also found that terrain pattern recognition and map information recall ability are skills that may be taught to individuals. Although these skills are not yet proven to be directly linked to one's ability to visualize the terrain, it is reasonable to argue that they would improve one's ability to quickly grasp the military significance of terrain.

Summary

The literature suggests that the commander's ability to visualize the battlefield is both a science and an art.[51] Military theory supports the idea that the commander's ability to visualize the terrain and its impact on operations is a critical skill in planning and conducting offensive operations.[52] The commander's primary tool for analyzing and assessing terrain when planning and conducting operations is the intelligence preparation of the battlefield process.[53] When reviewing Army doctrine, however, it appears that the IPB process is not directly linked to techniques for planning and conducting maneuver battalion offensive operations.

Army research has found that there may be skills associated with one's ability to visualize the battlefield environment. Military theory suggests that the commander's skills associated with understanding the components of terrain are vital when organizing forces for military operations. Army doctrine addresses the significance of terrain when planning operations, but falls short in specifying how terrain impacts on techniques and procedures. Continuity exist in both theory and research that suggests terrain visualization skills are associated with one's experience, on the ground (with a map),

solving problems dealing with space(to include elevation and relief), direction, distance and location.

Given the significance in developing the commander's terrain visualization skills, to what extent are they emphasized in the formal development of officers? More interestingly, has emphasis in developing these skills declined? Evidence provided in chapter one suggests, perhaps, that emphasis has decreased in developing the terrain visualization skills of officers.

METHODOLOGY

The research method was a comparative analysis of officer instruction conducted at the Army's Command and General Staff Officer Course. The analysis compared the amount of training that officers received in the development of terrain visualization skills during three different eras: 1939-40, 1969-70 and 1996-97. The periods selected provide a range for analysis which is representative of several different eras in the development of officers during the last sixty years. Each of the periods selected are unique in terms of the political, military and social climate that existed at the time in the United States.

Training conducted by officers just prior to WW II was characterized by developing skills associated with mechanized maneuver warfare. The industrial revolution that most modern states experienced during the inter war period between World War I and World War II, would forever change the shape of the battlefield and alter the method of warfare. In 1939 officers attending CGSOC were learning new skills, primarily how to conduct motorized and mechanized warfare. This posed new challenges in the development of officers which was largely due to the increased speed,

lethality and range of new weapon systems. This period was selected for analysis because it represents an era where officers were initially exposed to developing skills thought critical to maneuver warfare.

The period of 1969-70 was selected for analysis because it represents an era distinctly unique in the history of the United States. The threat of nuclear war with the Soviet Union and the conflict in Vietnam required that officers be trained to fight on both the convention and nonconventional battlefield. This period represents a time when officers attending CGSOC were provided instruction that prepared them for a host of different contingencies; maneuver warfare in Europe against the Soviet Union or Jungle warfare in Vietnam.

The last period selected for analysis is the most current, 1996-97. This period is selected for comparison to determine if emphasis has diminished in developing skills that may contribute to developing terrain visualization abilities from 1939-40 to the present.

The analysis included the training and instruction that officers received at the Army Command and General Staff Course (CGSOC). Students attending CGSOC are mid-level career officers with the highest possibility of commanding maneuver battalions within their cohort. Tactical skills learned at CGSOC are vital because the average amount of time maneuver officers have spent away from the last tactical assignment prior to their arrival is 48 months.[54] For officers, CGSOC is normally the last formal instruction they receive, except for the two week pre-command course, prior to being selected for battalion command. In addition, officers will usually only have one year of experience at the brigade level and below between attendance at CGSOC and becoming a battalion commander.

Criteria

The analysis compared the amount of time, in hours, students spent developing terrain visualization skills during CGSOC during the three periods selected. The criteria selected was derived from combining the findings of research presented in the review of literature. By combining the findings of research it is reasonable to suggests that the one's ability to visualize the terrain may be linked to the amount of exposure an officer has in developing specific skills. Research found that spatial orientation ability and one's ability to conduct terrain pattern recognition may enable one to quickly identify and quickly categorize the attributes of terrain.[55] Furthermore, the theory of expertise suggests that through training and exposure to many situations, expertise is developed. The theory of expertise suggests that experts are able to perceptually delineate subtle differences within the environment.[56]

The first criteria was the number of exercises and hours that required officers to use maps to solve tactical problems. Map exercises require officers to visualize from maps in terms of space-time and distance. Recalling from the literature, one's ability to classify terrain patterns and recognize spatial relationships may be taught.[57] Officers who conduct a variety of map exercises and associate the ground's spatial characteristics to battlefield activities are widening their experience. Experience may develop one's ability to develop mental models and visualize three dimensionally from two dimensional instruments.[58]

The second criteria was the number of exercises and hours that required officers to solve tactical problems using the ground. This criteria is closely related to experience

where officers actually associate features on the map with physical features on the ground. The theory of expertise stated that continuous exposure to multiple situations contributes to one's development of expertise.[59]

The specific comparison aimed at answering the research question included only those exercises where the students may have been required to use spatial orientation skills, terrain pattern recognition and were required to evaluate terrain based on the military significance to the tactical situation. Due to the way courses are designed, and the limited amount of information that can be deduced from course instructional manuals precise measurements of the amount of time developing officer terrain pattern recognition, spatial orientation, and terrain evaluation skills, are limited. However, as the theory of expertise explained, experience and exposure to situations requiring the use of these skills is key to developing expertise in them. The findings of this analysis will determine if emphasis on training mid-level officers on the possible development of terrain visualization skills has declined since the period when terrain visualization skills were initially identified as inherently relevant to the commander's ability to see the ground.

ANALYSIS

The purpose of this chapter is to present the analysis of data derived from the comparison of instruction conducted at CGSOC during three different periods. A thorough summary of analysis and interpretation of the data is contained in the next chapter.

The analysis includes more than just a comparison of instruction against the criteria. To gain an appreciation of the changes that have evolved since 1939 a general comparison of the overall core curriculum is also included. In addition, a general comparison is provided that illustrates all of the tactical and operational exercises that were conducted at CGSOC during the three years selected for analysis. Table One (below) illustrates the range and diversity of subjects, in hours allotted to study, in the core curriculum during the three periods selected for analysis.

Table 1. General Comparison of CGSOC Core Curriculum by Subject and Hours.

Subject	1939[60] Hours	1969[61] Hours	1996[62] Hours
Leadership	1*	26	32
Critical and Creative Thinking			24
Training	5	12	6
Resource Management		18	38
Logistics	73	28*	27*
History	51	50	72
Military Law	5	12	15
Doctrine	18*	20*	4*
Tactical Techniques	51	15*	10
Combat Operations	85	15*	128
Division Operations	192	232	93
Corps Operations	276	214	60
Military Opns Other Than War		25	45
Strategic Operations in Joint Env.	51	150	45
Advanced Fires			27**
Synchronization of Battalion Opns			81**
Applied Tactics			54**

* Additional time for these subjects is included under other headings
** Required for Functional Area 54 officers, may substitute for other tactical subjects

It is difficult to determine accurately the measurements in hours allotted to specific subjects because many of the areas overlap. For instance, in each period

covered, division operations overlap into corps operations. The hours listed are derived from the course program of instruction and many of the hours are lectures rather than measurements of time actually allotted to the subject area.

Analysis of the overall core curriculum illustrates that the quantity of subject areas has expanded by nearly 40% since 1939. The increase in core subjects since 1939 may reflect the necessity to broaden mid-level Army officer's exposure to subject areas which meet the demands of the various assignments officers may encounter in the field. This is especially evident in reviewing the core curriculum of 1969. During this period there was heavy emphasis throughout the course on jungle operations requiring heliborne operations, counter insurgence and guerrilla warfare.

It is also evident that as the core curriculum of CGSOC expands into new subject areas time allotted to any particular area may be affected. Obviously there are trade-offs that exist when the core curriculum of CGSOC is broadened. All of the CGSOC academic years lasted between 38 and 41 weeks. As additional subject areas are added, time allotted to other subjects are reduced. This is illustrated when comparing the time allotted to corps and division operations from 1939 to the present.

The comparison of time allotted to all instruction that may be associated with developing officer terrain visualization skills is illustrated in Table Two (below). This comparison represents the measurements of all tactical, operational and strategic exercises that CGSOC students could have participated in. Although this table represents a broader range of exercises then the criteria allows, it does provide a greater illustration of the emphasis on all exercises.

In comparing the number of exercises and hours allotted to training it is important to define the subject areas and the tasks associated with each. Map Reading includes lecture and practical exercises where students are required to demonstrate proficiency in reading the map. Map Maneuvers are exercises in which a military operation, with opposing sides, is conducted on a map. Map Exercises are exercises in which a series of military situations are stated and solved on a map. All students are required to solve the problems individually. Tactical Rides or walks are exercises in which military situations are studied and solved on the ground. Map Problems are exercises in which a military problem is solved in writing with a map. Terrain Exercises are exercises in which military problems are stated and solved on the ground in writing.

Table 2, Comparison of Instruction (1939-40 with 1996-97) in hours, and number of practical exercises allotted for developing skills associated with terrain visualization.

	1939-40[63]		1969-70[64]		1996-97[65]	
Subject/Area	PE	Hours	PE	Hours	PE	Hours
Map Reading	1	6	0	0	0	0
Map Maneuvers	8	82	18	64	12	230
Map Exercises	57	293	38	180	6	48
Tactical Rides	10	40	4	24	1	8
Map Problems	40	180	10	106	5	40
Terrain Exercise	21	84	0	0	0	0

Note: PE: Practical Exercise

Data compiled for year 1996-97 includes the core curriculum and the maximum amount of exercises one could receive if he elected (electives) to concentrate in subjects that may contribute to terrain visualization development.

The results of analysis indicate that mid-level officers who attended CGSOC in 1939-40 conducted 137 different exercises which required 685 hours to complete. This

total is significantly higher than the 24 exercises and 326 hours allotted to CGSOC students who attended in 1996-97. Probably more conclusive is the time students were actually exposed to terrain and required to solve tactical problems on the ground. The comparison of this criteria found that students in 1939-40 conducted 31 exercises and spent 124 hours physically assessing terrain when solving tactical problems. Officers attending in 1996-97 conducted only one terrain walk over a period of eight hours. Table Three (below) illustrates the comparison based on the criteria established.

Table 3, Analysis of the Criteria Between Selected CGSOC Years

	1939-40		1969-70		1996-97	
Criteria	PE	Hours	PE	Hours	PE	Hours
Criteria One	136	679	66	374	17	318
Criteria Two	31	124	4	24	0	0

Note: PE: Practical Exercises

The comparison above illustrates that time allotted to developing skills that may contribute to officer's terrain visualization ability has diminished since 1939. The first criteria shows that the number of military exercises that officers are currently required to perform has diminished significantly. Although the time allotted to conducting exercises was above 300 hours in 1996-97 it illustrates a reduction of nearly 50% from 1939-40. A comparison of the number of exercises between 1939 to 1996 shows that exercises have been reduced over 80%, from 136 to just 17.

FINDINGS AND RECOMMENDATION

Findings

Prior to American involvement in World War II officers attending CGSOC received an enormous amount of tactical level instruction requiring the use of maps and the ground. In 1939, much like today, regular Army units constituted only a small fraction of the manpower required for waging war. Just two years prior to U.S. commitment to World War II, it was understood that much of the officer training must be accomplished without the use of troops.[66] The reason for this was simple, the Army lacked the resources to conduct realistic maneuver training above the battalion level. On the list of resource shortfalls facing the Army was money, manpower, space and equipment. To compensate for the lack of large scale maneuver experience, within the officer corps, the United States Army Command and General Staff School placed much of its educational emphasis on developing the tactical skills of officers. The applicatory method of instruction was used, whereby officers where instructed on tactical and operational principles and methods and then applied their knowledge in solving tactical problems. The methods used for training officers included: map exercises, map maneuvers, map problems, tactical rides or walks, command post exercises, terrain exercises, staff rides or walks, historical rides, field exercises, and field maneuvers.[67]

The emphasis placed on map exercises and tactical problem solving using maps and the ground in 1969-70 had diminished since 1939-40. At this point very little emphasis was placed on conducting maneuvers or solving problems on the ground. Emphasis was split geographically between division and corps level operations conducted in both the jungle and European scenario. It may be that less emphasis was

placed on solving tactical problems due to the extensive combat experience that existed within the officer corps as a result of Vietnam. Analysis showed that there was a significant decline in time allotted and exercises conducted that may contribute to officer's terrain visualization abilities.

It is interesting to note that in 1939 most of the tactical and operational problem solving required individual solutions in writing or orally. Currently, the only individual terrain analysis requirements placed on officers during CGSOC is during exams, which are usually take-home requirements. Likewise, in 1969-70, officers were required to conduct only six exams requiring tactical problem solving using a map. Officers during that period were expected to perform individually and used maps to complete their work. In comparison, there has been a large departure away from requiring officers to assess, analyze and visualize terrain when completing exams. Presently, officers attending CGSOC do not usually require the use of a map, a sketch is often provided that does not represent terrain, vegetation, elevation or other spatial features. In addition, when solving tactical situations in the classroom, officers work as a group serving in assigned simulated staff positions.

Evidence presented in this monograph found that the time allotted during CGSOC to developing mid-level officer skills that may contribute to enhancing their terrain visualization ability has declined since 1939-40. Since 1939-40 less time is allotted during CGSOC conducting map exercises, terrain walks, tactical rides, and terrain exercises. In addition, less emphasis is placed on developing individual abilities that may contribute to enhancing terrain visualization skills. This is evident as officers who are presently attending CGSOC are only required to conduct a minimal amount of individual

tactical problem solving tasks. It is also evident that as time has progressed since 1940, the scope and breadth of instruction has increased.

Implications

Fortunately for American Army officers, terrain analysis became the central theme of training prior to War II.[68] Training included topographical drawings, terrain walks and long hours of map reading and instruction.[69] Today there seems to be a crowding-out of fundamental skill development in Army officer development for new requirements centered on management related areas. Research in this monograph highligted the importance of expertise in forming mental visions that may be necessary to developing battle command competencies. Expertise, however, is generally considered to be gained only from experience and training.[70] As experiential oppotunities decline and emphasis at Army educational institutions in developing skills that may contribute to visualizing the battlefield decreases, one would expect that developing officer's expertise would also diminish.

The Army has experienced several changes since the collapse of the Soviet Union and the ending of the Cold War. The Army recently completed a post Cold War down-sizing reducing the size of the Army from sixteen active Army divisions to just ten, all in just five years from 1990 to 1995. Simultaneously, the Army fought "Desert Storm" and has been actively involved in several global Operations Other Than War (OOTW), such as: Bosnia, Haiti, Somalia, Rwanda, and Saudi Arabia.[71] There are many concerns expressed by Army leaders at the highest levels that the combination of decreasing federal defense budgets coupled with increasing operations tempo (associated with non-

mission essential requirements) is having an adverse effect on readiness.[72] Combat arms officers gain most of their tactical experience during the initial twelve years of their career and have limited opportunities to serve in tactical units after departing CGSOC.[73] Today, combat arms officers departing CGSOC may be assigned directly to units deployed to Bosnia or Saudi Arabia, forgoing the opportunity to train and develop conventional war-fighting skills. Operations Other Than War do not give officers relevant maneuver experiences due to the non-METL related nature of these operations which range from peace-keeping to humanitarian relief operations. Units redeploying from OOTW must conduct intensive training to re-develop individual- and collective skills that deteriorate during OOTW operations. Given this, and the findings of this research, officers may not be receiving enough training that develops skills associated with the ability to visualize terrain.

As the Army defense budget is reduced cheaper methods of training and instruction are developed. Army maneuver battalions today are constrained by the amount of maneuver training they conduct on the ground.[74] The operations tempo (limits on mileage allotted to Army units for their vehicles maneuver training) of maneuver units is declining, which limits the amount of maneuver training they can do at their home stations. To off-set the effects caused by fewer opportunities to conduct realistic field training, the Army is relying more on cheaper alternatives. The Close Combat Tactical Trainer (CCTT), which is currently being fielded to units and the JANUS simulation trainer are just two tools that maneuver battalions are relying on more for maneuver experience.

As actual maneuver experience for officers declines one would think that the Army should place more emphasis on developing officer's fundamental skills during attendance at educational institutions.

Recommendation

The Army should place increased emphasis on developing skills at CGSOC that may improve officer's terrain visualization skills. This point is even more valid as the Army defense budget erodes and the Army's reliance on simulations increases. Theory suggests that maneuver officers must have an understanding of terrain to a level where they are able to visualize how the terrain impacts on operations before becoming a battalion commander.

To improve officer's terrain visualization abilities exercises are needed during CGSOC that require officers to associate the impact of terrain on operations. Officers need to gain an appreciation for the space, time and distance relationships that are affected by different environments when solving tactical problems. This may require more tactical rides, terrain exercises and individual requirements. The resident CGSOC is designed to ensure all branches are represented and with this comes the collective expertise of the Army. There may be utility in sharing understanding of the terrain amongst students during well planned tactical rides.

According to theory and research, the physics of the battlefield need to be understood by commanders to properly visualize how terrain impacts on operations. Although technology is improving tools to assist the commander's visualization of the ground, there can be little doubt that his judgment will remain grounded in his

understanding of terrain which is based on experience and training. Army plans to digitize the maneuver force which is aimed at improving the commander's situational awareness may eventually reduce some uncertainty on the battlefield. Regardless of the technology available to the commander, however, he will still rely on his visual and perceptual awareness to transfer information into understanding.

Limitations

This monograph has several limitations which impact on the conclusions of its findings. The analysis measured the amount of time officers spent conducting tactical exercises during three different periods. The quality and standards of training were not measured and surely this would have had some bearing on whether more exercises are better. Another limitation is the number of years selected. Only three years were used for comparison which limits the reliability of the findings. Although the academic years selected were adequately dispersed over the sixty years covered, an increase in academic years chosen for comparison would have added to the validity of the findings. The primary limitation of the monograph is that it only measures one type of officer training at one particular point in their career. The research does not account for the operational experience officers have and the training they receive. Surely maneuver officers develop terrain visualization skills during many of the exercises they conduct in the field and this level of development is not measured or accounted for.

Conclusion

The monograph began by providing evidence suggesting that maneuver battalion commander's may not properly understand how to visualize terrain when conducting

offensive operations. From there, a review of the literature identified several skills that may contribute to improving one's ability to visualize terrain. A research methodology was constructed to answer the question: has emphasis diminished in developing terrain visualization skills of mid-level CGSOC students? The analysis illustrated, based on the criteria, that the number of exercises and hours allotted to developing skills that may contribute to developing CGSOC students terrain visualization skills has diminished since 1939-40. The final chapter provided a summary of findings, the limitations of the research and recommendations.

This monograph was successful in answering a small question that is relative to a large concept that the Army is developing. The research of this monograph suggests that emphasis has diminished in developing officer skills during CGSOC that may improve their terrain visualization ability. The Army battlefield visualization concept suggests that improvements in technology will improve the commander's ability to see the ground, see the enemy, see friendly forces and predict the future. This monograph conducted a comparative analysis of instruction covering three academic years at CGSOC an based on criteria that was distilled directly from Army research, it was found that the current CGSOC course may not be allotting enough time conducting terrain and map exercises.

ENDNOTES

1. A.M. Gray, FMFM 1-3, Tactics, (Washington, DC: Department of the Navy, June 1991), 1. Passage is found in the forward of the publication.

2. Paul A. Jarrett, Analysis of Combat Training Center Archive Data for Critical Leader Behavior, (U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA: October 1995). 10; This definition is used frequently in other studies and is generally accepted. Although visualization may be defined the individual skills of the commander that enable visualization is still ill-defined. Based on my own research, expertise, metacognitive cognitive ability, memory recall ability, experience, intuition, and judgment may all contribute to some degree.

3. Ibid.

4. U.S. Army, FM 34-130, Intelligence Preparation of the Battlefield, (Washington, DC: Department of the Army, July 1994), 1-1.

5. Volume One, Advanced Warfighting Experiment, Operation Desert Hammer VI, Final Report, United States Army Armor Center, Mounted Warfighting Battle Space Lab, (Fort Knox, KY: July 1994), 9.

6. Center For Army Lessons Learned (CALL), National Training Center Priority Trends, U.S. Army Training and Doctrine Command, (Fort Leavenworth, KS: Jan. 1996), N-3-5, N-40-43; This document compiles positive and negative trends as observed at the NTC by observer-controllers. Many references are made throughout the pamphlet indicating that the intelligence preparation of the battlefield lacked coherent understanding by the staff and the commander. A consistent problem identified is the failure to wargame plans thoroughly.

7. Ibid., N-9.

8. Desert Shield/Desert Storm, Command Report, 1st Cavalry Division, Chapter VIII, Border/Screen Deception Operations, Archive historical documents, Fort Leavenworth, KS, p. 99-115. Within this report assets are identified that were available to the division from Corps and theater level to support the targeting needs for deception operations. It specifies that assets enabled the division to have a near real-time battlefield situation of enemy forces. The task force began operations at 1200 hours 20 Feb., after it had deployed a recon patrol the evening before. The task force made initial contact with five tanks in revetments. What is not clear from the report is if enemy locations and information (which were deemed to be accurate and timely) was made available to the task force commander prior to the recon-in force operation.

9. Ibid., 115.

10. Roger H. Nye, The Challenge of Command, (Wayne, New Jersey: Avery Publishing,, 1986), 63. Roger Nye doesn't footnote this idea, it seems to represent the body of knowledge he gained from analysis compiled in his study of battlefield commander's and other works. The "Challenge of Command" is based on research of Roger Nye conducted of prominent Army officers, including George S. Patton Jr.

11. Rex Michael and Julia Pounds, Critical Factor In the Art of Battle Command, U.S. Army Research Institute for the Behavioral and Social Sciences, (Fort Leavenworth, KS: July 1994), 10; The study list thirty competencies associated with battle command. Number seven and eight on the list are visualizing the terrain and the fight. This analysis is drawn from the collective wisdom of the observer controllers as the result of the focused rotational finding and conclusions of rotation 94-08.

12. Henry H Busciglio and Martha L. Teplitzky, Predicting Land Navigation Performance In the Special Forces Qualification Course, Technical Report 1015, U.S. Army Research Institute, (Alexandria, VA: 5 October, 1994), 4; This study applied the scientific approach to determine what individual factors could be contributing to high land navigation failure rates at the Army's Special Forces Training and Qualification School.

13. Desert Hammer VI, Final Report. This was stated in the section 'BOS-Maneuver 2."

14. Ibid., 1; The passage in Desert Hammer VI specifically states: "Digital visualization cannot be expected to be as timely or as accurate as visual situational awareness. The balance between digital and visual awareness depends on the time and space factors of a given situation and the level of command."

15. Nye, 63.

16. Desert Hammer VI, Final Report. Leaders, 1.

17. U.S. Army, FM 100-5, Operations, (Washington, DC: Department of the Army, June 1993), Glossary-1.

18. James W. Lussier and Terrill F. Saxon, Critical Factors in the Art of Battle Command, U.S. Army Institute for the Behavioral Sciences, (Fort Leavenworth, KS: July 1994), 2.

19. TRADOC Pamphlet, 525-70, Battlefield Visualization Concept, Headquarters, U.S. Army Training and Doctrine Command, (Fort Monroe, VA: October 1995), 3.

20. Stanley M. Halpin, The Human Dimensions of Battle Command: A Behavioral Science Perspective on the Art of Battle Command, U.S. Army Research Institute for the Behavioral Sciences, (Alexandria VA: Dec. 1994), 17-19; This research study attempts to identify the behavioral demands of the commander in the execution of battle command. It states that knowledge is not enough, that an individual needs certain thinking and reasoning skills to visualize.

21. Battlefield Visualization Concept, 3.

22. Ibid.

23. Ibid. 5.

24. Ibid. 3.

25. Ibid.

26. Thomas R. Phillips Ed., Roots of Strategy, (Harrisburg, PA: Stackpole books, March 1985), 341.

27. Carl von Clausewitz, On War, Ed. and Trans. by Michael Howard and Peter Paret, (Princeton, NJ: Princeton University Press, 1984), 109.

28. Ibid., 348.

29. Ibid., 361.

30. Ibid., 360.

31. Sun-tzu. The Art of War, Trans. Ralph D. Sawyer,(Westview Press, Boulder, CO: 1994), 140.

32. Ibid.

33. Ibid.

34. U.S. Army, FM 71-123, Tactics and Techniques for Combined Arms Heavy Forces: Armored Brigade, Battalion Task Force and Company Team. (Washington, DC: Department of the Army, Sep. 1992), iii.

35. Ibid.

36. Ibid., 3-33.

37. U.S. Army, FM 71-2, The Tank and Mechanized Infantry Battalion Task Force, (Washington, DC: Department of the Army, Sep. 1988), 3-54.

38. Pete Palmer and Jim Crider, Decision-Point Tactics, Combat Training Center Quarterly Bulletin, Center for Army Lessons Learned, (Fort Leavenworth, KS: Jan. 1997), I-1; The author defines decision point tactics early in his article. "Although not specifically titled decision-point tactics, the basic concept and technique of using decision

points is embodied in our current Army doctrine." Decision point tactics, as defined by the OPFOR, "is the art and science of employing available means at a specific point in space and/or time where the commander anticipates making a decision concerning a specific friendly course of action. This decision is directly associated with the threat force activity (action/reaction) and or the battlefield environment."

39. U.S. Army, FM 34-130, Intelligence Preparation of the Battlefield, 1-1.

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41. Soldier Training Publication 21-II MQS, Military Qualification standards for Lieutenants and Captains, (Washington, DC: Department of the Army, Jan. 1991), vi.

42. Ibid., 3-33.

43. Francis M. Ainsilie, Visualization of the Battlefield: Final Technical Report, Army Research Institute for the behavioral and Social Sciences, (Alexandria, VA: Dec. 1993), 20.

44. Ibid., 24.

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46. Halpin, 13-15.

47. Henry H Busciglio and Martha L. Teplitzky, 7.

48. Ibid., vii.

49. Cathleen Stasz and Perry W. Thorndyke, Individual Differences in Knowledge Acquisition From Maps, Office of Naval Research, Rand Corporation, (Santa Monica, CA: Jan. 1979), 34-35; This study included subjects who were both experts and novices in map reading. The study was designed to determine if training methods and strategies that were taught to the two groups would alter the expected correlation expected between experienced map readers and their score on tests that measured their ability to recall spatial information from maps.

50. Susan S. Fischer and James Geiwetz, Training Strategies for Tactical Pattern Recognition, United States Army Research Institute, For the Behavioral and Social Sciences, (Alexandria, VA: Feb. 1996), x; This research study measured terrain pattern recognition abilities of ROTC cadets from 83 different universities against that of active duty Army Captains. The cadets and Army captains were broken into two groups, those who received training prior to testing and those who did not. The findings were mixed, however, it was found that cadets who received training prior to testing scored about as well as Army captains who had also received the same training.

51. Battlefield Visualization Concept, 3.

52. Clausewitz, 348-360.

53. FM 34-130, Intelligence Preparation of the Battlefield, 1-1.

54. Gregory D. Reilly, How Experience Affects Confidence About Combat Decision Making, (Forth Leavenworth, KS: May 1997), 46; Data represents analysis from a survey of 100 infantry and armor officers attending CGSOC during academic year 1996-97. The survey of this study measured officer's tactical experience and the mean amount of time between tactical assignments during the course of their careers up to attendance at CGSOC.

55. Fisher and Geiwetz, 59.

56. Halpin, 16.

57. Fisher and Geiwetz, 59-61.

58. Halpin, 18.

59. Ainslie, 4.

60. Schedule for 1939-40, Regular Class, The Command and General Staff School, (Fort Leavenworth KS: Jan. 1939), 3-7; This the measure of core classes as listed in the course instructional program. Many of the subjects overlap making a precise measurement unfeasible. This is true for all of the measurements in this table which ensures the measurement is consistent.

61. United States Army Command and General Staff College, Program of Instruction, (Fort Leavenworth, KS: October, 1969), 3-6, 122-123.

62. The Command and General Staff Officer Course, General Curriculum, (Fort Leavenworth, KS: December 1996), Ch. 3, 13-17.

63. Instructional Notebook, The Preparation and Conduct of Tactical Exercises, Command and General Staff School, (Fort Leavenworth, KS: 1939), 7-9. Data also compiled from references listed above.

64. Program of Instruction, (Oct. 1969), 3-6, 122-123.

65. Command and General Staff Officer Course, December 1996, Ch 3; Data also compiled from C310- Combat operations, C320- Division and Corps operations, C520-Military Operations Other Than War, C510-Joint and Strategic Operations, C530-Theater Operations.

66. Faculty and Staff, Command and General Staff School, The Preparation and Conduct of Tactical Exercises, (Fort Leavenworth, KS: 1939), 8.

67. Ibid.

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70. Ainslie, 4.

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73. Michael T. Hayes, Battle Command: What Is It, Why It Is Important, and How To Get It, United States Army War College Research Project, (Carlisle Barracks, PA: April 1996), 15.

74. Sean D. Naylor, "Budget Bites Into NTC Rotation Fund," Army Times, (February 1994): 16. This article highlights how deep defense funding cuts are eating into the Army's training budget. It mentions that units scheduled to train at the NTC will have to now pay for the 250 miles of maneuver training per tank at the NTC. It is anticipated that units will feel the loss of a 17.5% reduction in training miles in 1997.

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